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STUDIES ON THE IGUANA TICK, *AMBLYOMMA DISSIMILE,* IN PANAMA *

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Some months ago while engaged in making a collection of the various species of snakes commonly found on the Isthmus of Panama, my attention was attracted by the number of specimens that were acting as hosts for the "iguana tick," *Amblyomma dissimile.* Over 60 per cent. of the total number of specimens collected were found to have ticks of this species attached to them. The 40 per cent. found to be free from ticks included a few that were aquatic in habits and a number of terrestrial varieties that were of a burrowing nature. Naturally, with such habits tick infestation is highly improbable. If only those specimens with habits *compatible* with infestation, such as the non-burrowing terrestrial and arboreal varieties, are taken, the numbers found with their parasitic associates tightly attached to them greatly exceed 60 per cent.

Besides being attached to snakes, this tick is also commonly found on toads and iguanas. Out of a number of these two latter animals received at this laboratory during the past two years, about 72 per cent. of the toads and 84 per cent. of the iguanas were found to be infested. Possibly this species may also attach itself to tortoises, small lizards, and other cold blooded animals, but so far the snakes, iguanas and toads have been found to be the common or representative hosts on the Isthmus.

On the snakes that have been collected I have found specimens of this tick in different stages of development, from the larval form to the sexually mature males and replete females. The larvae were found to be the more numerous. With some of the larger snakes a close search was necessary to find the small unengorged larvae, as they usually attach themselves beneath the scales of the host and are partly or entirely concealed, but a scrutiny beneath the scales usually resulted in exposing larvae. A slight raising of the scales of reptiles is strongly indicative of either the presence of larval ticks or small swellings caused by their having been attached previously. The nymphs when unengorged were also frequently found partly concealed beneath large scales, but when engorged were easily noticeable. Unengorged males and females were usually quite prominent. Altho the engorged females were not as numerous as the other forms, quite a number of them were found and in some instances were hanging from the side of the snake like globular pendants.

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* Read before the Medical Association of the Isthmian Canal Zone.

As the female of *A. dissimile* when fully replete is considerably larger than the other species of ticks found on the Isthmus — with possibly two exceptions — one may suspect that many of them before becoming fully engorged, are detached by the host passing swiftly thru thick grass, bushes and trees, over rough ground, sharp stones, etc. The engorged pendant females are prominent enough to catch on the many sharp edges of these objects and it is quite possible that many of them are torn loose in this manner during the travels of the host. It was noted that the ticks on the dorsal engorge to a larger size than those on the lateral or ventral surfaces. This is probably due to the fact that they escape the friction that those on the lower surfaces are subjected to, and also that those on the dorsum may use their claws and pulvilli to assist in holding them in position, while those on the sides and venter cling almost solely by their mouth parts.

Although *A. dissimile* has no apparent economic importance, a few studies were made on the bionomics and life history of this species in Panama which may be worthy of recording for the purpose of comparison with observations made on this tick in other localities. At the beginning of my observations, considerable difficulty was experienced in keeping suitable cold blooded hosts alive. Experiments were first tried with large toads, but they usually died within a few days when confined in cages small enough to control the dropping of the ticks. When placed in large cages and supplied with proper food they lived for considerable periods of time, but in the larger cages the smaller forms of the ticks could not be effectually controlled. As this did not give a definite record of the different stages, the use of toads for hosts was abandoned after a few trials. Iguanas were next tried and rejected for the same reason. Snakes gave the most satisfactory results as hosts.

Glass jars of three gallons capacity were used for containers. The first method adopted consisted in placing a snake in a jar and then dropping in the ticks to be observed. The top of the jar was then covered with a piece of light muslin, held in place with wide rubber bands. This prevented the escape of any of the ticks, yet allowed a sufficient air supply to prevent asphyxiating the host. Two faults were apparent with this method. First, that it necessitated the removal of the host from the container twice each day in order to search for ticks that had dropped, many of them being hidden between the coils of the snake and could not be found without removing the latter from the jar. Second, the snake lying on the bottom of the jar created a certain amount of moisture which had a tendency to affect the ticks.

In order to correct these faults it was necessary to devise an arrangement to keep the snake from resting on the bottom of the jar. This consisted in cutting out a circular piece of wire screening about one-half inch larger in diameter than the inside of the jar. This extra one-half inch was then turned down at a right angle all around the edge. A disk of white blotting paper was cut out and placed in the bottom of the jar, the screen with the turned edge downward then being placed on this paper disk. The turned edge of the screen kept it one-half inch above the paper. The snake was then placed in the jar on the screen, the mesh of which being one-half inch, allowed the ticks to drop thru on the paper as soon as they detached from the host. Usually they crawled beneath the paper on the bottom and could easily be noticed there by elevating the jar. The screen fitting the bottom of the jar tightly could not be displaced by the movements of the snake, which latter were always too large to crawl through the meshes. This arrangement proved to be very satisfactory.

The serpents used for hosts were adolescent specimens of the large boa, *Boa imperator,* mature specimens of the rainbow boa, *Epicrates cenchria,* and the tree snake *Oxybelis fulgidus.* The specimens selected were as large as the size of the jars would comfortably accommodate.

A series of four rearing experiments were conducted, of which I record but one. This one experiment not only represents a complete life cycle of *A. dissimile* for this region but also illustrates an instance of part of the larvae dropping to molt while the remainder molted on the host. This occurred in but one out of four experiments.

On September 17, 1916, a live specimen of *Epicrates cenchria* was captured near Balboa and presented to the laboratory. When received a female *A. dissimile* was found attached on the dorsal surface about 8 inches from the snake's head. Although but about three-fourths engorged, this tick was quite large. Engorgement was completed four days later and the tick dropped from the host on September 21. This replete female which was the largest specimen of *A. dissimile* that I have observed, measured 25 mm. in length, 15.5 mm. in width, 9 mm. in height and weighed 2.4 grams. After a preoviposition period of six days this female began depositing her eggs on September 27. Daily oviposition continued until October 31; covering a period of thirty-five days. The total number of eggs deposited was 9,254, which is the maximum observed from this species.

The eggs of this species are very light brown in color when first deposited and thinly coated with a transparent viscid substance which dries very quickly. A slight greenish tinge becomes apparent in a few days which gradually disappears as the eggs assume a darker shade of brown. Twenty-two days after they were deposited a white spot appeared on the side of each egg, caused by the development of the young embryo within the egg. These white spots becoming more pronounced as the embryos continued to develop, the eggs soon became considerably lighter on one side than on the other. An average egg measured 0.7 mm. in length, 0.5 mm. in diameter and weighed 0.143 milligrams.

The first eggs of this lot began hatching on November 6, and the last ones on December 8. This gave an average incubation period for each day's oviposition of practically 40 days. They all required about the same period of incubation.

When the young larvae emerged, the white spots noticed through the walls of the eggs were very pronounced and became more so when the larvae engorged. A newly emerged larva of average size measured 0.9 mm. in length, 0.5 mm. in width, weighed 0.2 mgm. and varied from gray to brown in color.

Within forty-eight hours after emerging the larvae separated from the mass of empty egg shells and swarmed in a cluster on the under side of the cover of the petri dish in which they were confined.

On December 30 about 200 of these young larvae were sprinkled over a constricting snake, *Boa imperator*. Within a few minutes they were actively crawling over the snake, and it appeared that when any of the scales were raised by its turning the larvae were ready to make their way beneath them. Many of them attached within fifteen minutes. When ready to attach the larva spread its legs, and after securing a grip on the skin with its claws, proceeded to force the hypostome into the skin, the palps meanwhile separating and spreading outward. It seemed to require but a few minutes and slight effort to insert the hypostome to full length. When this was accomplished the palps were extended at nearly right angles from it.

On the second day all unattached larvae were removed from the jar. The greater number of those attached were located on the dorsal surface, many of them being on the median line; some were also scattered over the lateral surfaces and a few were found on the ventral surface close to the vent.

As these larvae all began to engorge, the many scales beneath which they were attached became slightly elevated and caused the snake to have a peculiar rough appearance in place of the smoothness usually present.

Ninety-four engorged larvae dropped between January 10 and January 17 after an attachment period of from 11 to 18 days, the greater number detaching on the thirteenth day. The remaining larvae, altho all appeared to be completely engorged, maintained their attachment at the host and did not drop.

A replete larva of average size measured 2.2 mm. in length, 1.7 mm. in width, 0.7 mm. in height, and weighed 1.5 mgm. The color varied from pale drab to light brown and chestnut brown.

At from 6 to 10 days after dropping, during which time they moved about but very little and that rather slowly, the first stages of molting was manifested and they became practically motionless. At this time while the change from larva to nymph was slowly taking place, the outer skin became dry and shriveled with a white transparent appearance at the anterior end, which appearance increased as the changes within continued.

The nymphs all emerged between January 24 and January 28, the molting period being from 11 to 15 days, with the greater number emerging on the fourteenth day. However, in our other rearing experiments we have found larvae that engorged on toads to require as long as 19 days to molt. A few hours after emerging the young nymphs became quite active and traveled rapidly about in the rearing jars in which they were confined. At this stage their legs appeared to be out of proportion in length to their small bodies.

An unengorged nymph measured 2 mm. in length, 1.5 mm. in width, 0.7 mm. in height and weighed 0.8 mgm.

On February 15 these nymphs were placed on a "tree snake," *Oxybelis fulgidus,* which was 4 feet in length and about three quarters of an inch at its largest diameter. Many of the larvae attached quite readily, those that did not attach within 24 hours being removed from the jar. The first one to leave the host dropped on February 27, requiring but 11 days to engorge. The last one dropped on March 9 after a 22 day engorgement period. Among those that dropped last were a few that appeared to have been completely engorged for several days before dropping.

An average engorged nymph measured 5 mm. in length, 3.5 mm. in width, 2 mm. in height, weighed 29.5 mgm. As with the larvae, the color was not constant and varied with individuals, from a light drab to a deep brown. After a molting period of from 8 to 16 days, with the greater number emerging on the fourteenth day, the adults began to emerge. The first one emerged on March 14 and the last one on March 23. As the individuals that remained attached to the host the longest were those having the shortest molting period — the nymph with the 22 day attachment period molted in 8 days — it is possible that they remained attached for several days after apparent repletion and the molting process had begun before dropping occurred.

A newly emerged adult female measured 5.5 mm. in length, 4 mm. in width and weighed 7 mgm. The coloration was reddish brown with lighter colored ornamentations on the scutum.

It will now be necessary to return to the engorged larvae that were left on the *Boa imperator*. As previously stated, ninety-four of the larvae dropped engorged between January 10 and January 17 while the remainder did not detach altho apparently engorged. These larvae remained on the host and molted, and the nymphs also became engorged before dropping. The replete nymphs began dropping on February 8. The last one detached on February 28. After all the nymphs of this lot had dropped, the snake was examined closely and a few of the small cast larval skins were found still attached beneath the scales. During our many rearing experiments with this tick, this is the only instance in which molting occurred on the host, and we are unable to explain what caused the irregularity in this case. However, we are glad to have been able to witness this departure from the usual procedure, as a considerable difference of opinion seems to exist regarding the life history of *A. dissimile*. Newstead (1909), in writing of this species, states: "Both the nymphs and the females mature very slowly, and it is evident that all three stages (larva, nymph and adult) are passed upon one host; so that in this respect it differs markedly from its congeneric representative, *Amblyomma cajennense*, which requires three hosts and effects its two molts upon the ground. The life cycle of *A. dissimile,* therefore, resembles that of the common cattle tick (*Margaropus annulatus australis*). Hooker, Bishopp and Wood (1912), who found that this species dropped to molt and required three hosts, in mentioning the observations by Newstead say, "The only information upon the biology of this tick that the authors have found is furnished by Newstead (1909). This author is in error in supposing that the molts are passed upon the host, as such is not the case."

After observing the instance of part of the larvae dropping to molt while the remainder molted on the host, as previously stated, we can more easily understand the difference of opinion regarding the biology of this tick.

Thirty-four adults, 17 males and 17 females, were placed on a "rainbow boa" *Epicrates cenchria,* about 4½ feet in length, on April 9. Although these adults had remained quite dormant after emerging, they became very active when placed on a host and several were attached within twenty minutes. The following morning, April 10, four were found to be still unattached and were removed from the jar. The thirty that were attached, 16 females and 14 males, were all located on the dorsal surface of the host. Eleven of these were grouped in a small area, less than ¾ of an inch in diameter, about 4 inches from the head of the snake. Three inches from this group another cluster of eight were attached so closely together that they were lying partly on top of each other. The rest were scattered about over the dorsal and lateral surfaces. On April 11 it was noticed that some changing about had occurred and the number of individuals in the first cluster had increased to nineteen males and females intermingled. Several days passed without any signs of engorgement taking place, during which time the males detached and moved about quite frequently, and it is probable that copulation, which evidently takes place on the host, was necessary before the females began to engorge to any extent.

As the females became nearly engorged they began excreting small drops of white, chalky-like fluid. The first replete female left the host on April 26, after a 17-day attachment period, and nine more dropped between this date and April 30. An ulcer which had been developing at the area where the large cluster of ticks were attached became so serious at this time that the rest of the ticks were removed in order to save the snake. The lot removed were found in all stages of engorgement, from those fully engorged and about ready to detach to several that evinced no signs of repletion except for a slight thickening.

The engorgement period of the adult female seems to be quite variable; during the whole of our rearing experiments with this tick we have found the shortest period to be 15 days and the longest 36 days.

The average adult male when taken from a host was 5 mm. long, 3 mm. wide and was quite flat. It weighed 10.8 mgm., and the predominating color was brown with light ornamentations.

The coloration of an engorged female varied from gray to dark brown with yellowish markings; the scutum which was usually dark brown also having markings of a lighter hue. The integument of the entire body was thickly dotted with small, round, black spots, with a minute integumental pore in the center of each spot.

Altho these ten females were all apparently fully replete the weights and measurements varied considerably as shown by the following table:

TABLE 1.—WEIGHTS AND MEASUREMENTS OF ENGORGED FEMALES

Tick	Weight, Gm.	Length, Mm.	Width, Mm.	Height, Mm.
1	1.6845	19	14	9
2	1.5259	20	13	8
3	0.7175	16	10	7
4	1.6957	21	14	10
5	0.6763	15	9	6
6	1.2876	19	13	8
7	1.4980	21	13	8
8	0.9103	18	12	7
9	1.4776	20	13	8
10	1.6392	22	14	8

These ten females were placed in separate petri-dishes consecutively numbered and kept on a slightly darkened shelf out of all direct sunlight. During the first 2 or 3 days after dropping from the host, small quantities of the same chalk like fluid, discharged during the few days prior to dropping, was excreted by each female. Beginning within a few hours after dropping, and with some of the individuals extending up until several days after oviposition began, a small globule of serous like fluid was noticed issuing from each of the tiny pores located within the small black spots with which the integument was thickly dotted.

The period of preoviposition was quite short; the number of days elapsing between the dropping of the ticks to the beginning of oviposition is given below:

TABLE 2.—PREOVIPOSITION PERIODS

Tick No.	1	2	3	4	5	6	7	8	9	10
Days	5	5	5	7	6	4	4	4	5	4

When oviposition began the eggs were counted each morning, and those deposited during the preceding twenty-four hours were removed to a separate petri-dish. As oviposition continued and the females became depleted, the yellowish brown patterns on the dorsal surfaces became lighter in color and more pronounced.

The following table shows the oviposition periods and the number of eggs deposited by each tick daily:

TABLE 3.—DAILY OVIPOSITION

Date, May	Number of Eggs Deposited by Each Tick									
	1	2	3	4	5	6	7	8	9	10
1	406									
2	832	291	501			209	464			
3	468	720	640			631	733	533		
4	801	631	544		291	670	777	503		32
5	614	746	401	187	294	516	725	574	384	404
6	473	556	314	396	356	563	652	542		504
7		546	410	582	314	651	633	568		859
8		520	261	612	315	529	643	486		682
9		586	215	906	230	420	595	404	509	510
10		509	170	582	193	401	551	331	744	491
11		425	116	645	139	311	419	278	884	311
12		424	69	721	48	290	359	130	642	399
13		400	46	502	9	236	194	107	745	481
14		329	31	402		143	243	61	694	523
15		231	20	384		137	203	53	388	539
16		205	12	256		73	98	32	343	329
17		155	6	273		41	86	28	264	275
18		135	2	235		22	71	14	200	181
19		88	7	101		5	42	11	113	248
20		48		73			34	6	71	189
21		46		4			20	8	64	53
22		47					12	2	9	
23		21					7	2		
24		14		10			3			
25		6								
26		5		7						
Totals	3,594	7,684	3,765	6,878	2,189	5,848	7,564	4,673	6,054	7,010

The shortest incubation period of these eggs was thirty-eight days, and the longest forty-seven days.

Thruout this series of rearing experiments all the ticks were kept in the shade between two open windows. The temperature thruout the period during which these observations were conducted is given below.

TABLE 4.—AVERAGE TEMPERATURES PER MONTH

Months	Average Maximum	Average Minimum	Average Mean
	°F	°F	°F
September	85.4	73.3	79.4
October	82.8	73.2	78
November	83.8	72.3	78.1
December	86.2	72	79.1
January	86.6	70	78.3
February	86.9	69.4	78
March	87.8	72.1	80
April	88.4	72.2	80.3
May	85.2	73.4	79.3

No experiments were made to determine whether or not this tick in its various stages would attach to warm blooded hosts except in one instance when twenty larvae were placed in an uncovered pill box applied to the arm of the writer. This box was held with elastic bands for over 5 hours, but none of the larve attached during that time.

A few tests were made to determine the longevity of *A. dissimile* in the different stages of development. Of a number of larvae that were placed in a test tube on November 18, 1916, and allowed to remain perfectly dry about 5 per cent. remained alive for 101 days without any moisture. When confined in a large stender dish containing sand which was occasionally moistened some of the larvae lived for a period of 228 days. Nymphs when placed in a fairly damp situation remained alive for 162 days, but it was noticed that when placed in surroundings damp enough to cause the growth of molds that the nymphs died in less than 10 days. The greatest longevity period for unengorged females in the presence of moisture was 147 days.

No detailed observations were made to determine the length of time that adult males remained on a host, but at the present time a *Boa imperator* at the laboratory has two adult males attached to it that have been in situ for over 7 months. They have remained attached at apparently the same place during the whole of that time, regardless of the host shedding its skin several times during their attachment. This seems to be contrary to their habits when females are also present on a host.

In order to determine the length of submersion compatible with the life of this species a number of unengorged females were placed in a jar of water. They soon sank to the bottom and in about two hours became motionless. A few were removed each day to see if they were alive. When first taken from the water they always remained without motion and appeared to be dead for several hours, but if placed in the sunlight or other warm situation they became very active at the end of this time. The last female was taken from the water on the seventh day of submersion and was found to be alive.

When a large number of adults are present the habit of attaching in clusters often causes the death of the host when the latter happens to be a snake. We have had several specimens of serpents die from the effects of tick infestation when an excessive number was applied.

Usually the snake did not seem to mind when the ticks attached themselves except in extreme cases. We observed one highly nervous snake become very angry and excited when a female persisted in attempting to attach at the inner edge of the snake's upper lip. The latter shook its head violently and struck repeatedly at the side of the glass jar in an attempt to dislodge its tormentor. No other indications were noticed to show that reptiles and batrachians ever made any attempt to remove the ticks from themselves with their mouths or bite them.

If the skin of a snake, on which a number of ticks have been attached, is examined closely prior to shedding, it will be found to be very rough and covered with small abrasions and dried scabs.

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